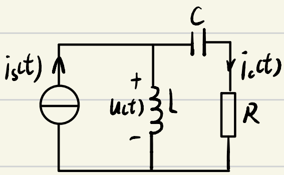
1.13

(1)



$$\begin{cases} \frac{1}{L}\int u(t)\,dt + i_c(t) = i_s(t) & ① \\ R i_c(t) + \frac{1}{C}\int i_c(t)\,dt = u(t) & ② \end{cases}$$

$\because i_c(t) = i_s(t) - \frac{1}{L}\int u(t)\,dt$ $\quad\therefore \frac{d^2u(t)}{dt^2} + \frac{1}{L}\frac{du(t)}{dt} + \frac{u(t)}{LC} = R\frac{d^2 i_s(t)}{dt^2} + \frac{1}{C}\frac{di_s(t)}{dt}$

$i_c'(t) = i_s'(t) - \frac{u(t)}{L}$

(2) 将②代入①中可得

$$\frac{1}{L}\int\left[R i_c(t) + \frac{1}{C}\int i_c(t)\,dt\right]dt + i_c(t) = i_s(t)$$

$$\therefore \frac{R}{L} i_c'(t) + \frac{1}{LC} i_c(t) + i_c''(t) = i_s''(t)$$

$$\therefore \frac{d^2 i_c(t)}{dt^2} + \frac{R}{L}\frac{di_c(t)}{dt} + \frac{1}{LC} i_c(t) = \frac{d^2 i_s(t)}{dt^2}$$

1.20

(b) 设3个积分器的输出为 $x(t)$, $x'(t)$, $x''(t)$

$\therefore$ $x'''(t) + 2x'(t) + 3x(t) = f(t)$

$y(t) = x''(t) - 4x(t)$

$3y(t) = 3x''(t) - 12x(t)$ $\qquad y'''(t) = x^{(5)}(t) - 4x'''(t)$

$2y'(t) = 2x'''(t) - 8x'(t)$

$\therefore \quad y'''(t)+2y'(t)+3y(t)=[x'''(t)+2x'(t)+3x(t)]''-4[x'''(t)+2x'(t)+3x(t)]$

$\therefore \quad y'''(t)+2y'(t)+3y(t)=f''(t)-4f(t)$

(d):

$x(k)=f(k)+2x(k-2)$

$x(k)-2x(k-2)=f(k)$

$2x(k)+3x(k-1)-4x(k-2)=y(k)$

$\therefore \quad -2y(k-2)=-2[2x(k-2)+3x(k-3)-4(k-4)]$

$\therefore \quad y(k)-2y(k-2)=2[x(k)-2x(k-2)]+3[x(k-1)-2x(k-3)]-4[x(k-2)-2(k-4)]$

$\therefore \quad y(k)-2y(k-2)=2f(k)+3f(k-1)-4f(k-2)$

(a)

$f(t)-2x(t)-3x'(t)=x''(t)$

$2x(t)+3x'(t)+x''(t)=f(t)$

$x''(k)-2x'(k)=y(t)$

$2y(t)=2[x''(k)-2x'(k)]$

$3y'(t)=3[x'''(k)-2x''(k)]$

$y''(t)=x''''(k)-2x'''(k)$

$\therefore \quad 2y(t)+3y'(t)+y''(t)=[2x(t)+3x'(t)+x''(t)]''-2[2x(t)+3x'(t)+x''(t)]'$

$\therefore \quad 2y(t)+3y'(t)+y''(t)=f''(t)-2f'(t)$

(c) $f(k)-4x(k-2)+2x(k-1)=x(k)$

$2x(k-1)-x(k-2)=y(k)$

$x(k)+2x(k-1)-4x(k-2)=f(k)$

$\because$

$-4y(k-2)=-4[2x(k-3)-x(k-4)]$

$2y(k-1)=2[2x(k-2)-x(k-3)]$

$\therefore \quad y(k)-4y(k-2)+2y(k-1)=2\left[x(k-1)+2x(k-2)-4x(k-3)\right]-\left[x(k-2)+2x(k-3)-4x(k-3)\right]$

$\therefore \quad y(k)-4y(k-2)+2y(k-1)=2f(k-1)-f(k-2)$

1.27

$f(t):\qquad y_1(t)=e^{-t}+\cos(\pi t) \qquad t\geq 0$

$2f(t):\qquad y_2(t)=2\cos(\pi t)$

$\because \quad y_1(t)=y_{zi}(t)+y_{zs}(t)=e^{-t}+\cos(\pi t) \qquad \therefore \quad y_{zs}(t)=\cos\pi t-e^{-t}$

$\quad y_2(t)=y_{zi}(t)+2y_{zs}(t)=2\cos(\pi t) \qquad \therefore \quad y_{zi}(t)=2e^{-t}$

$\therefore \quad y(t)=y_{zs}(t)+y_{zi}(t)=3\cos(\pi t)-3e^{-t}+2e^{-t}=3\cos(\pi t)-e^{-t}$

1.31

$y_{zi}(t)=\varepsilon(t)-2\varepsilon(t-1)+\varepsilon(t-2)$

$f(t)=\varepsilon(t)-\varepsilon(t-2)$

$\therefore \quad y_{1zi}(t)=\varepsilon(t)-2\varepsilon(t-1)+\varepsilon(t-2)-\left[\varepsilon(t-2)-2\varepsilon(t-3)+\varepsilon(t-4)\right]$

$\qquad =\varepsilon(t)-2\varepsilon(t-1)+2\varepsilon(t-3)-\varepsilon(t-4)$

$\because$ 第一个系统的输出为第二个系统的输入

$\therefore$ $y_2 z_i(t)$ 为 $y_1 z_i(t)$ 所产生的零状态响应

$y_2 z_i(t)=\varepsilon(t)-2\varepsilon(t-1)+\varepsilon(t-2)-2\left[\varepsilon(t-1)-2\varepsilon(t-2)+\varepsilon(t-3)\right]$

$\qquad +2\left[\varepsilon(t-3)-2\varepsilon(t-4)+\varepsilon(t-5)\right]-\left[\varepsilon(t-4)-2\varepsilon(t-5)+\varepsilon(t-6)\right]$

$$= \varepsilon(t) - 4\varepsilon(t-1) + 5\varepsilon(t-2) - 5\varepsilon(t-4) + 4\varepsilon(t-5) - \varepsilon(t-6)$$